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Relationship Characteristics and HIV Transmission Risk in Same-sex Male Couples in HIV Serodiscordant Relationships

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Abstract

Unprotected anal intercourse (UAI) remains a main risk factor for HIV among men who have sex with men (MSM) and this is of particular concern for partners of HIV serodiscordant status. However, HIV transmission risk has been demonstrated to vary by the sexual position adopted among partners. Guided by interdependence theory, this study examined how relational factors were differentially associated with risk taking (HIV-positive/insertive and HIV-negative/receptive) and strategic positioning (HIV-positive/receptive and HIV-negative/insertive) UAI withinserodiscordant same-sex male couples. HIV-positive men and their HIV-negative partners ($n_{couples}$=91; $n_{individuals}$=182) simultaneously but independently completed computerized questionnaires and HIV-positive men had blood drawn for viral load.A minority of couples (30%) engaged in risk taking and/or strategicpositioning unprotected anal sex. Results of multinomial logistic regressionindicated that HIV-negative partners' levels of relationship commitment were positively associated with the odds of engaging in both risk taking and strategic positioning sexual behaviors. For HIV-negative partners, reports of relationship intimacy, autonomy, and sexual satisfaction were negatively associated with odds of reporting risk taking behavior. In contrast, HIV-positive partners'reported sexual satisfaction was positively associated with odds of engaging in risk taking behavior. Findings suggested that aspects of relational quality may be differentially associated with sexual decision making for same-sex male couples in serodiscordant relationships. Study findings lend support for the incorporation ofdiscussions of HIV risk reduction strategies, enhancing communication between partners, and support for general relationship functioning in HIV care.

Keywords

HIV; serodiscordant couples; Sexual behavior; Gay men; relationship quality; sexual orientation

In the U.S., men who have sex with men (MSM) continue to be the most heavily impacted group at risk for HIV acquisition (Centers for Disease Control, 2010) and a large proportion of HIV risk behavior occurs within the context of primaryrelationships (Davidovich et al.,

2001; Dolcini, Coates, Catania, Kegeles, & Hauck, 1995; Marin, Tschann, Gomez, & Kegeles, 1993; McCoy & Inciardi, 1993; Reilly & Woo, 2004; Weinhardt et al., 2004). Research has demonstrated the critical role that couples play in HIV prevention. For example, Sullivan,Salazar, Buchbinder, and Sanchez(2009)estimated that 68% of new HIV infections among MSM–and 80% of new infections among younger MSM were contracted from main partners. More recently, Goodreau, Carnegie, Vittinghoff, Lama, and Sanchez (2012) estimated that 39% of new HIV infections in the U.S. were transmitted between main partners.

As a result, a burgeoning body of literature has examined correlates of sexual risk behavior between main partners and with outside sexual partners among gay male couples (Hoff, Beougher, Chakravarty, Darbes, & Neilands, 2010; Hoff et al., 2009; Mustanski, Newcomb, & Clerkin, 2011; Parsons, Starks, Du Bois, Grov, & Golub, 2013). While HIV transmission has been attributed to extradyadic sexual risk behavior, unprotected anal sex within serodiscordant couples represents a transmission risk as well. Intradyadic sexual risk behaviors are of particular concern for partners of serodiscordant status(where one partner is HIV seropositive and the other is HIV seronegative). Within these relationships, unprotected anal intercourse (UAI) represents an inherent risk of HIV transmission if the HIV-negative partner is in the receptive role or the HIV-positive partner's viral load is detectable (Hallett, Smit, Garnett, & de Wolf, 2011; Vernazza, Hirschel, Bernasconi, & Flepp, 2008).

Existing studies have found that gay men in serodiscordant relationships do not use condoms consistently for anal sex, despite knowing the risk of infection to the HIV-negative partner and re-infection in the HIV-positive partner (Brooks et al., 2012; Nieto-Andrade, 2010; Remien, Carballo-Diéguez, & Wagner, 1995). Some studies have suggested that HIV-negative men use their HIV-positive partners' viral load to aid in decisions about whether or not to engage in UAI with their HIV-positive partners (Crepaz, Hart, & Marks, 2004; Prestage et al., 2009; Van de Ven et al., 2005; Van Den Boom et al., 2013). HIV prevention researchers have also suggested that seroadaptive behaviors (i.e., strategic positioning) may be driven in part by "prevention altruism" among HIV-positive MSM to keep their HIV-negative partners negative (Golub, Tomassilli, & Parsons, 2009; Nimmons & Folkman, 1999).

For over a decade, studies have recognized the adoption of seroadaptive behaviors among gay men, such as negotiating insertive/receptive roles for anal intercourse to inform decision-making about unprotected sex with their partners (Parsons, Schrimshaw, & Wolitski, 2005). In studies among gay men, strategic sexual positioning-HIV-positive/ receptive and HIV-negative/insertive–has been perceived by some men to be of considerably lower or minimal risk with regard to HIV transmission (McFarland et al., 2011; Parsons et al., 2005; Van de Ven et al., 2002). However, few studies distinguish typologies of risk behavior when examining correlates of sexual risk behavior among couples. Serodiscordant couples who engage in UAI engage in risk behavior; however, this behavior may take two forms. They may engage in risk taking behaviors (i.e., HIV-positive/insertive and HIV-negative/receptive) or risk-reduction behaviors, such as strategic positioning (i.e., HIV-positive/receptive and HIV-negative/insertive).

Interdependence theory (Kelley, 1984; Rusbult & Van Lange, 2003) has been applied to HIV risk behaviors among gay male couples in positing that gay men in relationships make decisions regarding their sexual behavior with primary and outside partners based on a number of relationship factors, such as intimacy, autonomy, equality, commitment, and satisfaction (Davidovich, de Wit, & Stroebe, 2006; de Vroome, Stroebe, Sandfort, de Wit, & Van Griensven, 2000; Mitchell & Petroll, 2013). For gay men, UAI has been described as a way of showing love and intimacy to one another (Appleby, Miller, & Rothspan, 1999; Blais, 2006; Davidovich, de Wit, & Stroebe, 2004; de Vroome et al., 2000; Fitzpatrick et al., 1994; McNeal, 1997; Worth, Reid, & McMillan, 2002). Relationship commitment and sexual satisfaction have also been associated with gay male couples engaging in UAI (Davidovich et al., 2006). While each of these studies make important contributions to HIV prevention efforts, some have not included data from both partners (Davidovich et al., 2006), others have only examined seroconcordant HIV-negative gay couples (Mitchell & Petroll, 2013), and most have not examined different types of sexual behavior, such as risk reduction behaviors among serodiscordant couples (Hoff, Chakravarty, Beougher, Neilands, & Darbes, 2012).

To our knowledge, there are no studies that have examined the association between each partner's appraisal of relationship quality and sexual risk behavior for same-sex male couples in serodiscordant relationships.Moreover, given the inherent risk of transmission present in UAI within serodiscordant same-sex male couples and the importance of main partnerships as a context for HIV transmission risk behavior, it is important to understand relationship factors associated with unsafe behavior within these dyads to inform population-specific prevention strategies. As a preliminary step to better understanding the nuances in sexual risk taking, this article aimed to (1) examine the relationship characteristics associated with unprotected anal sexual activity among same-sex male couples in serodiscordant relationships and (2) determine whether relationship characteristics were differentially associated with sexual risk taking, strategic positioning, and no unprotected anal sexual behavior.

METHOD

Participants

Table 1 shows the demographic data. The sample was largely middle-aged (*M* = 46.9 years; *SD* = 10.3 years) and self-identified as White (61.0%). Approximately half of the sample reported earning more than $20,000 annually (61.0%) and had less than a bachelor's degree (50.5%). The mean length of time since HIV-positive diagnosis was 13.8 years (*SD*= 7.6) and the mean length of relationship was 98.41 months (*SD* = 95.0). Note, where partners' reports of relationship length differed, the average relationship length reported by couple members was used.

Procedure

Study findings were from baseline interviews of an ongoing longitudinal, mixed-methodsobservational cohort study of same-sex male couples that examined relationship dynamics and HIV medication adherence where at least one partner wasHIV-positive and

taking antiretroviral medications (Johnson et al., 2011). All procedures were reviewed and approved by the Committee on Human Research, the Institutional Review Board (IRB) at the University of California, San Francisco.

Couples were recruited in the U.S. San Francisco Bay Area using passive recruitment methods and participant and provider referrals. Couples who called the study were screened separately for eligibility criteria and eligible participants were scheduled for an in-person interview at the research center. Both partners were required to attend the appointment together, but were consented and assessed separately. To be eligible for the parent project, both partners must have defined their relationship as primary, meaning they felt committed to their partner above anyone else and had a sexual relationship. At least one partner in each couple was HIV-positive and on an acknowledged ART regimen for at least 30 days, which was verified by medication bottles or an official medication list from a pharmacy or health care provider. In addition, participants were: (1) at least 18 years old; (2) born male and currently identified as male; (3) English speaking; (4) informed about their own and their partner's HIV status; and (5) able to provide informed consent. Surveys were administered with a combination of Computer Assisted Personal Interviewing and Audio Computer Assisted Self Interviewing (ACASI) procedures.

In response to recruitment efforts, 791 individuals called the study screening line. Of those, 658 (83.1%) were interested in the study and agreed to be screened, with 552 (69.9%) men meeting the study's basic eligibility criteria. In total, 35 couples screened eligible but did not enroll in the parent project. Of these 35 couples, 6 did not enroll in the project because one partner was not interested in participating and 29 couples repeatedly did not show up or cancelled schedule appointments. The total sample for the parent project comprised of 482 men (241 couples) who met the parent project's eligibility criteria and completed baseline appointments. Analyses for the present study were restricted to serodiscordant couples (*N* =91 couples, 182 men) who completed baseline interviews between January 2009 and December 2011.

Measures

Demographics—Participants reported their age, sexual identity, race and ethnicity, HIV serostatus (positive or negative), education level, and income level.Participants also provided the duration of the primary relationship (in months).

Sexual Behavior—Sexual behaviorduring the previous three months was assessed using four items. Two items assessed whether or not the participant engaged in insertive and receptive anal sex with their main partner (“yes/no” response). Two subsequent items assessed how often condoms were used during insertive and receptive sex (“never,” “sometimes,” “half of the time,” “most of the time,” “every time”). Because social desirability would most likely result in under-reporting of sexual risk behavior, where discrepancies occurred in partners’ reports, these were resolved in the direction of greater risk. Couples were identified as engaging in strategic positioning UAI (HIV-positive receptive/HIV-negative insertive) if either the negative partner reported insertive anal sex and condoms were not used every time or the positive partner reported receptive anal sex

and condoms were not used every time. Likewise, couples were identified as engaging in risk taking (HIV-positive insertive/ HIV-negative receptive) when either the HIV-negative partner reported receptive anal sex and condoms were not used every time or the HIV-positive partner reported insertive anal sex and condoms were not used every time. Couples who engaged in both activities were coded as engaging in risk taking so that the strategic positioning UAI category was preserved for those who engaged in that strategy exclusively.

Couple-level agreement with regard to the occurrence of individual types of UAI was high. When data were combined to create a three-category variable (no UAI, only HIV-positive receptive/HIV-negative insertive, HIV-positive insertive/HIV-negative receptive), couple-level agreement remained high (86.8%). Table 2 shows the correspondence of partners' sexual behavior reports. Where discrepancies occurred, level of risk was not associated with HIV status. In seven couples, HIV-negative participants reported a higher level of sexual risk, while in five couples HIV-positive partners reported higher levels of sexual risk.

Relationship Quality—A modified version of Kurdek's (1998) Relationship Quality scales assessed four dimensions of relationship quality. The inventory contained 23 items and participants were asked to indicate their level of agreement on a Likert scale ranging from 1 (Not atall True) to 9 (Extremely True). For each scale, high scores reflect high levels of the construct. Four items assessed relational commitment (e.g., "I am committed to maintaining my relationship with my partner," α = 0.96); six items assessed relational intimacy (e.g., "I get so close to my partner that I'm not sure where he begins and I end,"α= 0.76); five items assessed relational autonomy (e.g., "My sense of being an individual is separate from my sense of being part of a couple,"α = 0.74); and eight items assessed relational equality (e.g., "My partner and I have equal power in the relationship,"α = 0.91).

Sexual Satisfaction—A four item scale (Gamarel et al., 2013) assessed sexual satisfaction (e.g., "How satisfied are you with your sexual relationship with your partner in general?" α = 0.84). Participants responded using a Likert-type scale (1 = *Extremely Dissatisfied* to 6= *Extremely Satisfied*).

Viral Load—Trained phlebotomists using standard techniques obtained blood for plasma HIV RNA viral load during the assessment visit. The viral load test was performed using the COBAS® AmpliPrep/COBAS®TaqMan_ HIV test kit (Roche Molecular Systems, Inc.), which has a threshold for undetectability of 20copies/ml. Viral load was dichotomized as undetectable versus detectable.

Statistical Analysis

We initially examined differences between HIV-negative and HIV-positive partners on demographic variables and relationship factors. Many common statistical tests assume that dependent variable observations are independent of one another. Violations of assumptions of independence may result in increased Type I or Type II error (Kenny & Judd, 1986; Kenny, Kashy, & Cook, 2006). Therefore, we initially examined partner-similarity (non-independence) prior to conducting tests comparing HIV-negative and HIV-positive partners. Where indicated, we chose statistical tests which accounted for the presence of non-

independence (e.g., dependent sample *t*-tests). Notably, this issue is distinct from the issue of multicollinearity, which is typically assessed by examining Tolerance or Variance Inflation Factor statistics (O'Brien, 2007). Multicollinearity assesses the presence of redundancy among predictor variables whereas these analyses assessed the non-independence of observations due to the nesting of individuals within couples.

HIV serodiscordant couples represent distinguishable dyads.That is, within each couple, members differ with regard to HIV status, and HIV status has potentially meaningful implications for the theoretical constructs examined.In such cases, Pearson's product-moment correlations (Pearson's *r*) may be used to assess the relationship between HIV-negative and HIV-positive partners' scores on a particular continuous variable (Kenny et al., 2006); however, Pearson's *r* is a measure of relative–rather than absolute–association. This means that two members of the same couple may have very different scores as long as those differences are systematic across all couples. For example, if HIV-negative men consistently reported younger age than HIV-positive partners, Pearson's *r* might be very high even though couple members differ in the actual values they reported. Pearson's *r* can be interpreted as a measure of absolute agreement only after accounting for mean differences in the two correlated variables.

In the case of distinguishable dyads, when both variables were centered, Pearson's *r* is equal to the intra-class correlation (ICC) and guidelines for the assessment of consequential non-independence have been discussed more generally in terms of this latter metric (Kenny, Kashy, & Bolger, 1998). Similar to Pearson's *r*, the ICC varies between -1 and +1 (in the special case of dyads). An ICC of zero implies that two members of the same couple are no more similar to one another than two members of different couples are. As the ICC increases in absolute value, it implies couple member's responses are increasingly similar to (or dissimilar from) one another.An ICC of 1.0 indicates that members of the same couple responded identically. Cohen's Kappa is an analogous measure of association for dichotomous variables and interpretation of Cohen's Kappa is identical to that of the ICC coefficient (Kenny et al., 2006). Kenny et al.(1998) concluded that data may be treated as independent observations in the presence of minor violations of this assumption (ICC < .45). Using this rationale, we first examined the degree of dependence present in variables to verify that selected statistical tests were appropriate.

The associations among couples' sexual behavior and partners' reports of relationship functioning were tested using multinomial logistic regression, due to the nominal nature of outcome variable categories. While "no UAI," "strategic positioning," and "risk taking" represent increasing levels of HIV transmission risk, they also represent qualitatively different forms of behavior and therefore cannot be appropriately ordered in a manner that conforms to assumptions of ordinal regression (Long, 1997). The primary outcome variable exists at the couple-level. That is, both members of the couple share the same value on the outcome. This couple-level outcome was regressed on HIV-positive and HIV-negative partners' reports of relationship functioning. Models also included age of both partners, the viral load (detectable/undetectable) of HIV-positive partners, and mean relationship length.

RESULTS

Table 1 contains data related to participant's evaluation of relationship factors, including autonomy, equality, commitment, intimacy, and sexual satisfaction. Partners' evaluation of commitment, equality, and sexual satisfaction were significantly dependent upon one another.Higher scores among HIV-positive men were associated with higher scores reported by their HIV-negative partners.Educational attainment and race/ethnicity were also similar among HIV-positive and HIV-negative men. This level of interdependence was below the threshold which would meaningfully impact inferences based upon assumptions of independence (Kenny et al., 1998). Results of independent sample *t*-tests suggested that the responses of HIV-positive men and their HIV-negative partners did not differ from one another on any of the relationship factors assessed. Notably, as a check on the influence of interdependence, results of dependent sample *t*-tests were also examined and identical conclusions were reached.Overall, HIV-positive men earned less than HIV-negative men, and men who earned more than $20,000 annually were more likely to have a partner who also earned more than $20,000 annually.

With regard to HIV transmission behavior, 28 couples (30.8%) reported engaging in UAI in the past three months. Of these couples, 14 (50.0%) reported risk taking (HIV-positive insertive/HIV-negative receptive). Of these, six reported engaging in risk taking exclusively, while eight couples engaged in both risk taking and strategic positioning (HIV-positive receptive/HIV-negative insertive). Finally, 14 couples engaged in only strategic-positioning.

Relationship Factors and HIV Transmission Risk

A multinomial regression was conducted to predict the couples' UAI category (i.e., no UAI, strategic positioning, or risk taking). The three-category outcome was regressed on each partners' age, the viral load (detectable vs. undetectable) of HIV-positive partners, relationship length, and measures of relationship functioning. The model represented a significant improvement over the null model, Log-likelihood $\chi^2(28) = 51.28$; $p < .01$. Table 3 contains regression parameters associated with relationship variables resulting from these analyses. Note, in order to generate parameters illustrating associations among all possible combinations of outcome categories, a redundant model was calculated using an alternative referent.

Strategic positioning UAI vs. no UAI—Only HIV-negative partners' reports of relationship commitment were positively associated with the odds of engaging in strategic positioning UAI vs. no UAI (aOR = 1.28, 95% CI= 1.001, 1.62; $p = .05$). No other relationship functioning variables differentiated between these two sexual behavior categories. With regard to covariates, the age of HIV-negative partners was negatively associated with the odds of engaging in strategic positioning vs. no UAI (aOR = 0.89, 95% CI= 0.79; 0.99; $p = .03$). Parameters associated with the age and viral load of HIV-positive partners and relationship length were all non-significant.

Risk taking UAI vs. no UAI—HIV-negative partners' reports of sexual satisfaction (aOR = 0.74; 95% CI = 0.55, 0.99, $p = .05$) and intimacy (aOR = 0.81; 95% CI = 0.66, 0.98; $p = .03$) were negatively associated with engaging in risk taking vs. no UAI. In contrast, HIV-

positive partners' reports of sexual satisfaction were positively associated with the odds of engaging in risk taking vs. no UAI (aOR = 1.31; 95% CI = 1.01, 1.70; p = .04). No other relationship functioning variables differentiated between these two sexual behavior categories. With respect to covariates, the age of HIV-negative partners was negatively associated with engaging in risk taking vs. no UAI (aOR = 0.82; 95% CI = 0.71, 0.93; p< . 01) while the age of HIV-positive partners was positively associated with engaging in risk taking vs. no UAI (aOR = 1.14; 95% CI=1.01, 1.28; p = .04). Parameters associated with the viral load of HIV-positive partners and relationship length were all non-significant.

Risk taking UAI vs. Strategic positioning UAI—A redundant model was calculated to determine the significance of parameters in differentiating between these two types of sexual behavior. HIV-negative partners' reports of sexual satisfaction were negatively correlated with engaging in strategic positioning vs. risk taking (aOR = 0.72, 95% CI = 0.52, 1.00, p = . 05), meaning that higher levels of sexual satisfaction among HIV-negative partners was associated with a lower likelihood of engaging in risk behavior vs. strategic positioning. No other relationship variables differentiated between these two sexual behavior categories. Parameters associated with the age of HIV-positive and HIV-negative partners, HIV-positive partners' viral load, and relationship length were non-significant.

DISCUSSION

This study was one of the first quantitative investigations to examine whether relationship characteristics were differentially associated with risk taking, strategic positioning, and no intra-dyadic unprotected anal sexual behavior in a diverse sample of serodiscordant same-sex male couples. While a minority of couples (30%) engaged in risk taking and/or strategic positioning UAI, our findings suggested that relationship dynamics were associated with different intra-dyadic sexual risk behaviors. Two overarching findings emerged from the current study that may contribute to the growing body of literature on HIV transmission among same-sex male couples.

First, our findings suggested that HIV-negative partners' perceptions of relationship quality were positively associated with engaging in strategic positioning. Specifically, HIV-negative partners' perceptions of commitment were positively associated with engaging in strategic positioning, compared with not engaging in unprotected anal sexual activity. Similarly, HIV-negative partner's reports of sexual satisfaction were positively associated with engaging in strategic positioning, such that higher levels of sexual satisfaction were associated with increased odds of engaging in strategic positioning compared with risk taking. These findings were consistent with qualitative studies that have found commitment and intimacy tobe linked with intradyadic sexual risk behavior among serodiscordant couples(Nieto-Andrade, 2010; Remien et al., 1995), yet they suggest a more nuanced examination of typologies of sexual behavior may better capture these associations. Specifically, our findings suggested that HIV-negative men who engage in strategic positioning were not only protecting themselves but also maintaining sexual intimacy and commitment in their relationship.

Second, HIV-negative partners' reports of intimacy and sexual satisfaction were negatively associated with risk taking, compared with not engaging in UAI. In contrast, HIV-positive partners' reports of sexual satisfaction were positively associated with the odds of engaging in risk taking, compared with no UAI. There may be important discrepancies in appraisals of relationship quality for some men in serodiscordant couples. Remien et al.(1995) found that for some gay men in serodiscordant couples who engaged in intradyadic sexual risk behavior, communicationbecame inhibited because both partners wanted to protect each other from thinking about their fears of transmission. As such, some of the HIV-positive partners in our sample who reported both higher levels of sexual satisfaction and risk taking behaviors may be unaware of their partners' perceptions of relationship functioning. Thus, communication between partners may be diminished as result of unexpressed fears about HIV transmission or protective buffering and many aspects of the relationship can be negatively affected. These findings are particularly noteworthy as much of the existing research on gay male couples and HIV transmission has attributed incidence rates to UAI with outside partners (Goodreau et al., 2012; Sullivan et al., 2009). Thus, future research is warranted to examine how dyadic coping strategies (i.e., mutual problem solving and open communication) moderate the association between relationship quality and different sexual behaviors.

Contrary to the findings of others, viral load suppression was not significantly related to sexual behavior in this analysis. Notably, our study did not assess each partner's perception of the threat of HIV transmission (Lewis et al., 2006; Salazar, Stephenson, Sullivan, & Tarver, 2013). While studies suggest that HIV-negative men may factor their HIV-positive partners' viral load into decisions about whether or not to engage inUAI with their HIV-positive partners (Crepaz et al., 2004), it is possible that participants in the current sample were less aware of the link between viral suppression and HIV transmission and/or the potential utility of strategic positioning (vs. abstinence from UAI) as a mechanism for HIV risk reduction. Future research is warranted to better ascertain each partner's beliefs about HIV transmission and HIV-negative partner's awareness of their partner's viral load.

Results related to age and relationship duration suggest potential directions for future developmental research. First, there was a strong negative association between HIV-negative partner's age and engagement in both strategic positioning and risk taking UAI. In other words, older HIV-negative men were more likely to abstain from UAI completely with their HIV-positive partners. The current analyses did not explore whether this decline in overall UAI resulted from decreased engagement in sexual activity generally or increased use of condoms within the context of relatively stables levels of overall engagement in sexual behavior. These age-related declines in both types of UAI assessed occurred in the absence of associations between relationship length and sexual behavior outcomes. Notably, the older age was associated with increased odds of engagement in sexual risk taking (vs. no UAI) among HIV-positive partners. This pattern of findings points to the possibility that reductions in HIV-transmission risk behavior are more related to the age of individual partner members rather than the duration of the couple's relationship. Additional data are needed to identify trajectories of individual and relationship sexual behavior development. Future research should examine the effects of age disparities and the interaction of HIV status with such disparities.

The present study illustrated the complexity of sexual behavior and relationship dynamics among serodiscordant couples. Clinicians and service providers working with men in serodiscordant relationships should be attuned to relationship functioning and sexual behaviors. Diminished relationship functioning may serve as barriers to implementing harm-reduction strategies among some couples engaging in HIV transmission risk behaviors. As these data were correlational in nature, future research is needed to determine whether poor relationship functioning is a vulnerability for intradyadic and extradyadic HIV transmission risk behavior or whether engagement in such behavior diminishes perceptions of relationship functioning over time.

There were limitations of this study worth noting. First, it should be noted that many relationship factors were not significantly related to sexual behavior outcomes. The current sample was sufficient to support the analyses conducted; however, the sample size was modest and null findings should be conservatively interpreted. These results are best viewed as broadly supporting future research on interdependence theory and sexual health by providing an indication of the relevance of relationship factors to HIV-transmission risk behavior within serodiscordant same-sex male couples. Second, this study relied on a convenience sample and, as such, findings may not be generalizable. It is particularly important to note that all of the HIV-positive men in this study were prescribed antiretroviral medications and resided in a geographic region where there have been efforts to ensure connection to comprehensive HIV prevention and care, which restricts our ability to generalize these results to other gay and bisexual men in serodiscordant couples in different regions. Third, measures were based on self-report and might be affected by recall error and social desirability bias, although ACASI technology was employed to minimize these biases. Fourth, our dependent measures were crude indicators of sexual risk behavior and we lacked more refined indicators of sexual behavior, such as day level assessments (Radloff, 1977) and diary studies (Badr, Pasipanodya, & Laurenceau, 2013), which provide ecological validity and reduce recall bias (Laurenceau & Bolger, 2012). Fifth, this study was cross-sectional and, therefore, causal or temporal interpretations cannot be inferred. Finally, our findings suggest that younger HIV-negative men were more likely to engage in risk taking and strategic positioning sexual behavior. However, many of the couples in this study lived through the HIV epidemic where AIDS had a huge impact on all of their lives. Therefore, our findings may be different from those with younger cohorts.

Notwithstanding these limitations, this study provided further support for the inclusion of couples-based HIV prevention strategies for same-sex male couples in serodiscordant relationships in HIV care and treatment. Our findings suggest that HIV-negative partners in serodiscordant relationships who are engaging in strategic positioning report increased commitment and sexual satisfaction whereas lower intimacy and sexual satisfaction were associated with engaging risk taking behaviors. However, HIV-positive partners' reported increased sexual satisfaction when engaging in risk taking behaviors, compared with no UAI. To date, there is limited research and clinical care for same-sex males in serodiscordant couples. Further research into the role of relationship factors and novel bio-behavioral interventions, such as treatment as prevention (TasP), which simultaneously targets specific sexual position typologies among same-sex male couples in serodiscordant relationships, is warranted. Additionally, study findings suggest the potential importance of

incorporating discussions of sexual risk behavior within the relationship, communication between partners, and support for general relationship functioning within HIV care settings.

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REFERENCES

Appleby PR, Miller LC, Rothspan S. The paradox of trust for male couples: When risking is a part of loving. Personal Relationships. 1999; 6:81–93.

Badr H, Pasipanodya EC, Laurenceau JP. An electronic diary study of the effects of patient avoidance and partner social constraints on patient momentary affect in metastatic breast cancer. Annals of Behavioral Medicine. 2013; 45:192–202. [PubMed: 23150234]

Blais M. Vulnerability to HIV among regular male partners and the social coding of intimacy in modern societies. Culture, Health, & Sexuality. 2006; 8:31–44.

Brooks RA, Landovitz RJ, Kaplan RL, Lieber E, Lee S, Barkley TW. Sexual risk behaviors and acceptability of HIV pre-exposure prophylaxis among HIV-negative gay and bisexual men in serodiscordant relationships: A mixed methods study. AIDS Patient Care & STDs. 2012; 26:87–94. [PubMed: 22149764]

Centers for Disease Control and Prevention. Vital signs: HIV testing and diagnosis among adults—United States, 2001-2009. Morbidity and Mortality Weekly Report. 2010; 59:1550–1555. [PubMed: 21124295]

Crepaz N, Hart TA, Marks G. Highly active antiretroviral therapy and sexual risk behavior. Journal of the American Medical Association. 2004; 292:224–236. [PubMed: 15249572]

Davidovich U, de Wit J, Albrecht N, Geskus R, Stroebe W, Coutinho R. Increase in the share of steady partners as a source of HIV infection: A17-year study of seroconversion among gay men. AIDS. 2001; 15:1303–1308. [PubMed: 11426076]

Davidovich U, de Wit JBF, Stroebe W. Behavioral and cognitive barriers to safer sex between men in steady relationships: Implications for prevention strategies. AIDS Education and Prevention. 2004; 16:304–314. [PubMed: 15342333]

Davidovich U, Wit J, Strobbe W. Relationship characteristics and risk of HIV infection: Rusbult's investment model and sexual risk behavior of gay men in steady relationships. Journal of Applied Social Psychology. 2006; 36:22–40.

de Vroome EMM, Stroebe W, Sandfort TGM, de Wit JBF, Van Griensven GJP. Safer sex in social context: Individualistic and relational determinants of AIDS-preventative behavior among gay men. Journal of Applied Social Psychology. 2000; 30:2322–2340.

Dolcini MM, Coates TJ, Catania JA, Kegeles SM, Hauck WW. Multiple sexual partners and their psychosocial correlates: The Population-based AIDS in Multiethnic Neighborhoods (AMEN) study. Health Psychology. 1995; 14:22–31. [PubMed: 7737069]

Fitzpatrick R, Dawson J, McKechnie R, Hart G, McLean J, Boulton M. Regular partners and risky behaviour: Why do gay men have unprotected intercourse? AIDS Care. 1994; 6:331–341. [PubMed: 7948089]

Gamarel KE, Starks TJ, Dilworth SE, Neilands TB, Taylor JM, Johnson MO. Personal or relational? Examining sexual health in the context of HIV serodiscordant same-sex male couples. AIDS and Behavior. 2013 doi:10.1007/s10461-013-0490-4.

Golub SA, Tomassilli JC, Parsons JT. Partner serostatus and disclosure stigma: Implications for physical and mental health outcomes among HIV-positive adults. AIDS and Behavior. 2009; 13:1233–1240. [PubMed: 18843532]

Goodreau SM, Carnegie NB, Vittinghoff E, Lama JR, Sanchez J. What drives the US and Peruvian HIV epidemics in men who have sex with men (MSM)? PloS ONE. 2012; 7 Retrieved fromhttp://dx.doi.org/10.1371/annotation/9a6a0c8e-2d01-4f36-9ab8-f9fdfce6497b.

Hallett TB, Smit C, Garnett GP, de Wolf F. Estimating the risk of HIV transmission from homosexual men receiving treatment to their HIV-uninfected partners. Sexually TransmittedInfections. 2011; 87:17–21.

Hoff CC, Beougher SC, Chakravarty D, Darbes LA, Neilands TB. Relationship characteristics and motivations behind agreements among gay male couples: Differences by agreement type and couple serostatus. AIDSCare. 2010; 22:827–835.

Hoff CC, Chakravarty D, Beougher SC, Darbes LA, Dadasovich R, Neilands TB. Serostatus differences and agreements about sex with outside partners among gay male couples. AIDS Educations and Prevention. 2009; 21:25–38.

Hoff CC, Chakravarty D, Beougher SC, Neilands TB, Darbes LA. Relationship characteristics sssociated with sexual risk behavior among MSM in committed relationships. AIDS Patient Care and STDs. 2012; 26:738–745. [PubMed: 23199191]

Johnson MO, Dilworth SE, Taylor JM, Darbes LA, Comfort ML, Neilands TB. Primary relationships, HIV treatment adherence, and virologic control. AIDS &Behavior. 2011; 16:1511–1521. [PubMed: 21811842]

Kelley HH. The theoretical description of interdependence by means of transition. Journal of Personality and Social Psychology. 1984; 47:956–982.

Kenny, D.; Kashy, D.; Bolger, N. Data analysis in social psychology.. In: Gilbert, D.; Fiske, S.; Lindsey, G., editors. Handbook of social psychology. 4th ed.. McGraw-Hill; New York: 1998. p. 233-265.

Kenny DA, Judd CM. Consequences of violating the independence assumption in analysis of variance. Psychological Bulletin. 1986; 99:422–431.

Kenny, DA.; Kashy, DA.; Cook, WL. Dyadic data analysis. Guilford Press; New York: 2006.

Kurdek LA. Relationship outcomes and their predictors: Longitudinal evidence from heterosexual married, gay cohabiting, and lesbian cohabiting couples. Journal of Marriage and the Family. 1998; 60:553–568.

Laurenceau, JP.; Bolger, N. Analyzing diary and intensive longitudinal data from dyads.. In: Mehl, MR.; Conner, TS., editors. Handbook of research methods for studying daily life. Guilford Press; New York: 2012. p. 407-422.

Lewis MA, McBride CM, Pollak KI, Puleo E, Butterfield RM, Emmons KM. Understanding health behavior change among couples: An interdependence and communal coping approach. Social Science & Medicine. 2006; 62:1369–1380. [PubMed: 16146666]

Long, JS. Regression models for categorical and limited dependent variables. Sage; Thousand Oaks, CA: 1997.

Marin BV, Tschann JM, Gomez CA, Kegeles SM. Acculturation and gender differences in sexual attitudes and behaviors: Hispanic vs non-Hispanic white unmarried adults. American Journal of Public Health. 1993; 83:1759–1761. [PubMed: 8259813]

McCoy HV, Inciardi JA. Women and AIDS: Social determinants of sex-related activities. Women Health. 1993; 20:69–86. [PubMed: 8493800]

McFarland W, Chen YH, Raymond HF, Nguyen B, Colfax G, Mehrtens J. HIV seroadaptation among individuals, within sexual dyads, and by sexual episodes, men who have sex with men, San Francisco, 2008. AIDS Care. 2011; 23:261–268. [PubMed: 21347888]

McNeal JL. The association of idealization and intimacy factors with condom use in gay male couples. Journal of Clinical Psychology in Medical Settings. 1997; 4:437–451. [PubMed: 12348422]

Mitchell JW, Petroll AE. Factors associated with men in HIV-negative gay couples who practiced UAI within and outside of their telationship. AIDS and Behavior. 2013; 17:1329–1337. [PubMed: 22790903]

Mustanski B, Newcomb ME, Clerkin EM. Relationship characteristics and sexual risk-taking in young men who have sex with men. Health Psychology. 2011; 30:597–605. [PubMed: 21604883]

Nieto-Andrade B. The effect of HIV-discordance on the sexual lives of gay and bisexual men in Mexico City. Journal of Homosexuality. 2010; 57:54–70. [PubMed: 20069494]

Nimmons D, Folkman S. Other-sensitive motivation for safer sex among gay men: expanding paradigms for HIV prevention. AIDS and Behavior. 1999; 3:313–324.

O'Brien RM. A caution regarding rules of thumb for variance inflation factors. Quality & Quantity. 2007; 41:673–690.

Parsons JT, Schrimshaw EW, Wolitski RJ. Sexual harm reduction strategies of HIV-seropositive gay and sexual men: Serosorting, strategic positioning, and withdrawal before ejaculation. AIDS. 2005; 19(Suppl. 1):S13–S25. [PubMed: 15838191]

Parsons JT, Starks TJ, Du Bois SN, Grov C, Golub SA. Alternatives to monogamy among gay male couples in a community survey: Implications for mental health. Archives of Sexual Behavior. 2013; 42:303–312. [PubMed: 22187028]

Prestage G, Mao L, Kippax S, Jin F, Hurley M, Grulich A, Zablotska I. Use of viral load to negotiate condom use among gay men in Sydney, Australia. AIDS and Behavior. 2009; 13:645–651. [PubMed: 19199021]

Radloff LS. The CES-D scale: A self-report depression scale for research in the general population. Applied Psychological Measurement. 1977; 1:385–401.

Reilly T, Woo G. Social support and maintenance of safer sex practices among people living with HIV/AIDS. Health & Social Work. 2004; 29:97–105. [PubMed: 15156842]

Remien RH, Carballo-Diéguez A, Wagner G. Intimacy and sexual risk behavious in serodiscordant male couples. AIDS Care. 1995; 7:954–1021.

Rusbult CE, Van Lange PMA. Interdependence, interaction and relationships. Annual Review of Psychology. 2003; 54:351–375.

Salazar LF, Stephenson RB, Sullivan PS, Tarver R. Development and validation of HIV-related dyadic measures for men who have sex with men. Journal of Sex Research. 2013; 50:164–177. [PubMed: 22206480]

Sullivan PS, Salazar L, Buchbinder S, Sanchez TH. Estimating the proportion of HIV transmissions from main sex partners among men who have sex with men in five US cities. AIDS. 2009; 23:1153–1162. [PubMed: 19417579]

Van de Ven P, Kippax S, Crawford J, Rawstorne R, Prestage G, Grulich A, Murphy D. In a minority of gay men, sexual risk practices indicates strategic positioning for perceived risk reduction rather than unbridled sex. AIDS Care. 2002; 14:471–480. [PubMed: 12204150]

Van de Ven P, Mao L, Fogarty A, Rawstorne P, Crawford J, Prestage G, Kippax S. Undetectable viral load is associated with sexual risk taking in HIV serodiscordant gay couples in Sydney. AIDS. 2005; 19:179–184. [PubMed: 15668543]

Van Den Boom W, Stolte IG, Witlox R, Sandfort T, Prins M, Davidovich U. Undetectable viral load and the decision to engage in unprotected anal intercourse among HIV-positive MSM. AIDS and Behavior. 2013; 17:2136–2142. [PubMed: 23525838]

Vernazza, P.; Hirschel, B.; Bernasconi, E.; Flepp, M. HIV-positive individuals without additional sexually transmitted diseases (STD) and on effective anti-retroviral therapy are sexually non-infectious.. Schweizerische Ärztezeitung/Bulletin des médecins suisses/Bollettino dei medici svizzeri,89(5). 2008. Retrieved from http://www.ternyata.org/books/wisdom/swiss_english.pdf

Weinhardt LS, Kelly JA, Brondino MJ, Rotheram-Borus MJ, Kirshenbaum SB, Chesney MA, Gore-Felton C. HIV transmission risk behavior among men and women living with HIV in 4 cities in the United States. Journal of Acquired Immune Deficiency Syndrome. 2004; 36:1057–1060.

Worth H, Reid A, McMillan K. Somewhere over the rainbow: Love, trust in monogamy in gay relationships. Journal of Sociology. 2002; 38:237–253.

Table 1

Demographic Characteristics and Relationship Functioning (N= 182)

	Overall	HIV-positive Partner	HIV-negative Partner	test statistic	κ
Race		n (%)	n (%)	$\chi 2(3) = 0.8$	.06
Black	21 (11.5)	10 (11.0)	11 (12.1)		
White	111 (61.0)	55 (60.4)	56 (61.5)		
Latino	32 (17.6)	18 (19.8)	14 (15.4)		
Other	18 (9.9)	8 (8.8)	10 (11.0)		
Income				$\chi 2(1) = 12.2^{**}$	$.25^{**}$
$20,000 or more	111 (61.0)	44 (48.4)	67 (73.6)		
< $20 000	71 (39.0)	47 (51.6)	24 (26.4)		
Education				$\chi 2(1) = 2.2$	−.11
College or more	90 (49.5)	50 (54.9)	40 (44.0)		
Less than college	92 (50.5)	41 (45.1)	51 (56.0)		

	M (SD)	M (SD)	M (SD)	test statistic	ICC
Age	46.9 (10.3)	46.7 (9.6)	47.1 (11.1)	t (90) = 0.4	$.49^{**}$
Sexual Satisfaction	15.0 (6.3)	16.2 (11.2)	15.0 (11.9)	t (180) = −0.8	$.31^{**}$
Autonomy	33.1 (8.6)	33.5 (7.5)	32.6 (8.0)	t (180) = 0.7	−.02
Equality	28.0 (6.8)	27.8 (6.9)	28.3 (6.6)	t (90) = −0.7	$.46^{**}$
Commitment	32.4 (5.6)	32.6 (5.5)	32.1 (5.6)	t (180) = 0.6	$.19^{*}$
Intimacy	37.5 (9.1)	36.9 (9.9)	38.1 (8.1)	t (180) = −0.9	.16

NOTE: Dependent samples t tests were utilized where consequential non-independence was indicated (ICC ≥ .45). All variables in which ICC or κ < .45 were tested using independent samples t tests and χ^2 tests of independence.

$^{*}p < .05$

$^{**}p < .01$

Table 2

Agreement in Partners Reported Engagement in Sexual Behavior

	HIV Positive Partner		
HIV Negative Partner	**No UAI**	**Seropositioning**	**Deliberate Risk Taking**
No UAI	63 (69.2)	2 (2.2)	3 (3.3)
Sero-positioning	3 (3.3)	9 (9.9)	0 (0.0)
Deliberate Risk Taking	2 (2.2)	2 (2.2)	7 (7.7)

Table 3

Multinomial Logistical Regression Model Predicting Sexual Behavior (N = 182)

Variable Type	Strategic Positioning vs. No UAI		Risk vs. No UAI		Risk vs. Strategic Positioning	
	OR	95%CI	OR	95%CI	OR	95%CI
HIV-positive partner						
Age	1.07	0.96, 1.20	1.14*	1.01, 1.28	1.06	0.92, 1.21
Autonomy	0.92	0.81, 1.05	0.97	0.86, 1.10	1.05	0.89, 1.23
Equality	0.99	0.83, 1.19	1.01	0.80, 1.27	1.02	0.78, 1.33
Intimacy	0.10	0.81, 1.02	0.95	0.86, 1.06	1.05	0.91, 1.21
Satisfaction	1.15	0.95, 1.39	1.31*	1.01, 1.70	1.15	0.86, 1.53
Commitment	0.96	0.79, 1.16	1.47	0.92, 2.32	1.53	0.94, 2.49
HIV-negative partner						
Age	0.89*	0.79, 0.99	0.82**	0.71, 0.94	0.92	0.80, 1.07
Autonomy	0.95	0.82, 1.10	0.90	0.86, 1.10	0.95	0.80, 1.14
Equality	1.05	0.89, 1.24	1.26	0.95, 1.67	1.20	0.90, 1.62
Intimacy	0.93	0.82, 1.07	0.81*	0.66, 0.98	0.86	0.70, 1.07
Satisfaction	1.04	0.87, 1.23	0.74*	0.55, 0.99	0.72*	0.52, 1.00
Commitment	1.28*	1.01, 1.62	1.33	0.97, 1.81	1.04	0.74, 1.47
Couple-level						
Relationship length	0.99	0.97, 1.00	0.99	0.98, 1.01	1.00	0.98, 1.02
Viral suppression	4.71	0.62, 35.89	0.74	0.17, 12.09	0.30	0.03, 3.75

** $p<0.01$

* $p\leq.05$